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ABSTRACT

This report examines the meaning and utility of several different desegregation-related measures relevant to Federal policy and technical assistance. Following the introduction, Section II discusses alternative measures of school segregation and desegregation. Major indices are compared, using a hypothetical school district for illustrative calculations. This comparison is extended to show the effects of modifying school racial composition in various ways, and observations are offered about commonly-used measures of school segregation. Section III examines the reduction of racial isolation measures used to determine the allocation of Emergency School Aid Act funds, and offers an alternative that can further decrease bias against districts with large minority populations by correcting for changes in a district's overall racial composition. An addendum to the section presents a comparison of three indices for measuring the severity of racial isolation. The final section offers a simple model for considering the costs and benefits of desegregation over time, in terms of "white flight" or resegregation. (CMG)

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ANALYSES OF MEASURES OF SEGREGATION AND DESEGREGATION

Charles Clotfelter

Final Report

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Education Policy Development Center for Desegregation

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Table of Contents

		Page
I.	Introduction	1
	Purposes of the Study	1
II.	Alternative Approaches to Measuring School Segregation and Desegregation	2
	Why Measure Segregation?	3
	Two Major Types of Segregation Indices	4
	A Comparison of Several Major Segregation Indices	8
	Comparison of Relative Indices	13
	Conclusion and Evaluation	24
III.	Computing the "Effective Net Reduction" in Racial Isolation in the Award of ESAA Funds	28
	Introduction	28
	Ambiguities in Defining "Racial Isolation"	28
	The Two-Index Solution	29
	Simulation	30
	Base Case	30
	Time Two	30
	Conclusion	33
	Addendum	34
IV.	Desegregation, Resegregation and Net Benefits Over Time	37
	A Model of Desegregation and White Flight	41
	References	46

ANALYSES OF MEASURES OF SEGREGATION AND DESEGREGATION

Charles Clotfelter

I. Introduction

Purposes of the Study

Various quantitative measures are used to measure the extent of segregation, the rate of desegregation, and the consequences of desegregation. These measures have, with respect to changes in opportunities for interracial contact, had important implications for the allocation of federal program funds, the funding of efforts to correct civil rights violations, and assessments of the effectiveness of alternative desegregation strategies.

This report examines the meaning and utility of several different desegregation-related measures relevant to federal policy and technical assistance. Its objectives are:

1. To identify various quantitative measures that are used and might be used in making decisions in desegregation policy at the federal level.
2. To describe the characteristics of alternative measures that might be used for the same purpose.
3. To provide some bases for improving the assessment at both the federal and local level of the consequences of desegregation efforts. Assessments of local effectiveness have been relevant not only to the determination of fund allocation under ESAA but to the provision of technical assistance under Title IV of the Civil Rights Act (CRA). While the responsibility for funding desegregation efforts once funded by ESAA has been transferred to the states since this report was commissioned, fund alloca-

tions at the state level, as well as state enforcement activities, will probably rely on status measures such as those discussed in this report.

Three types of measures are examined in this study:

1. Measures relating to the degree of racial isolation (or "racial balance") in a district.
2. The reduction of racial isolation measure used in determining the allocation of ESAA funds.
3. Measures assessing the consequences of white flight or "resegregation."

The analysis is based on four methods of inquiry:

1. Review of the relevant literature.
2. Examination of the application for ESAA funds to determine procedures used by local governments.
3. Interviews with federal and local officials who employ these measures.
4. Simulation, where appropriate, of the use of different measures to demonstrate the different conclusions that might be reached if one measure rather than another was employed.

II. Alternative Approaches to Measuring School Segregation and Desegregation

This section discusses alternative measures of school segregation and desegregation. Part A outlines the motivation for such measures. Part B distinguishes two major types of indices. Part C compares the indices in more detail, using a hypothetical school district for illustrative calculations. Part D extends this comparison to show the effects of modifying school racial compositions in various ways, and Part E concludes the section.

Why Measure Segregation?

A great deal of scholarly work has been devoted to the development and testing of various ways to measure segregation. As will be noted below, such activity has important uses in academic research and policy. But not the least among the reasons for all the work in this area is the existence of good data on the racial composition of residential areas and schools, enabling researchers to test and use their indices.

Researchers have found that it is quite useful to have a single measure of segregation. The attempt to measure segregation using a single index has similarities to other attempts to measure complex distributions with one number. Inevitably, a great deal of information is lost in such a measure, but the concomitant benefit is simplification. It is important, therefore, to weigh the gains in simplification against the information lost. In addition, it is useful to explore the characteristics of various measures.

It is possible to distinguish two uses of segregation indices. First, they may be used in scholarly studies of race relations, urban economics, or education. One principial application is to measure the degree of "racial isolation" experienced by individuals. The second major use is in the evaluation of public policies to reduce segregation. Segregation indices may be used directly, as with ESAA, and OCR, in the allocation of budget funds.

In measuring school segregation, the notion of racial isolation has particular relevance. But what is meant by racial isolation? Does it apply to minorities only, or to all students? Is "isolation" a continuous or dichotomous state? Assuming it applies to all students, one might

express the aggregate amount of racial isolation in a school district as

$$I = \sum_{k=1}^{oK} I_k N_k$$

where N_k is the number of students in school type k and I_k is the amount of racial isolation in school type k. On the other hand, "racial isolation" may refer only to minority students, who may be isolated from the majority population.

Figure 1 depicts several possible racial isolation functions in which some index of isolation (seriousness) is plotted against racial composition. Figures 1A and 1D imply that schools with racial compositions above or below a certain level are defined as "isolated" and others are acceptable. This dichotomous breakdown does not allow for gradations in the degree of isolation. The other functions do allow for gradations, however. As will be seen below, these functions have their counterparts in segregation indices.

Leaving aside the question of continuous or dichotomous measures, what points should be used in determining what schools are subject to isolation? If isolation measures psychological or social damage from being separated from the mainstream of society, should the limiting points (M_0, . . . , M_4) be defined in terms of the district, the larger urban area, or the nation? Is a black student in an all-black school in Boston any more isolated than a black student in an all-black school in Washington? If the answer is Yes, other measures of isolation ought to account for the racial composition of the district in defining "isolation." This implies that isolation and segregation ought to be measured <u>relative</u> to overall racial composition.

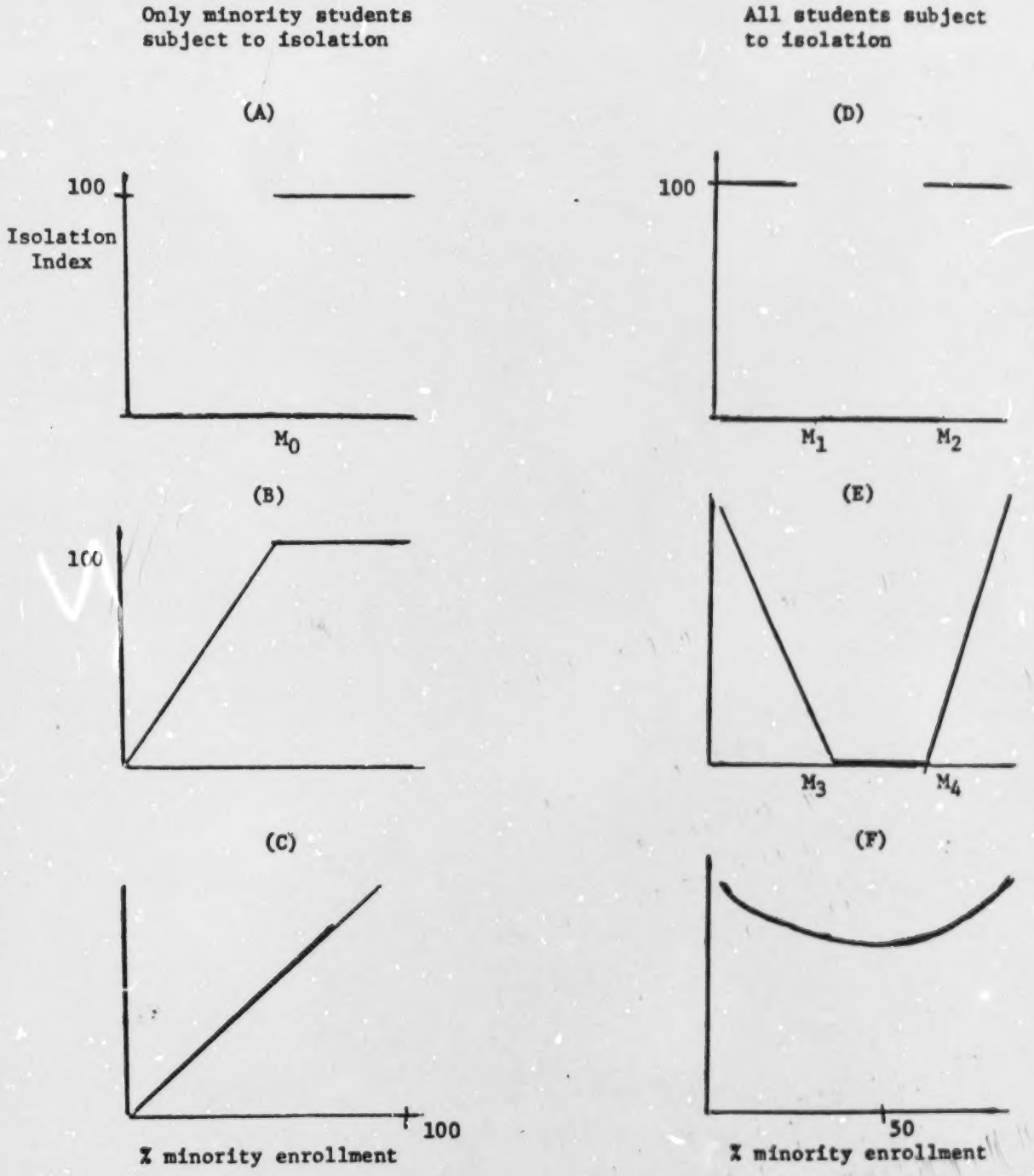
<u>Two Major Types of Segregation Indices</u>

One could divide up the indices used to measure school segregation and desegregation into two groups: absolute and relative. <u>Absolute</u> indices

Figure 1

Racial Isolation as a Function of

Racial Composition



measure the actual degree of racial contact, proximity or isolation observed in school enrollment patterns without any regard to the overall racial makeup of the school district. For example, if "racial isolation" is defined as schools with less than 5 percent or more than 95 percent minority enrollment, then one absolute measure is the proportion of students in such schools.

Relative measures account for the fact that isolation is more difficult to avoid in districts with very high or very low proportions of minorities. One could argue that it is unfair to use the same measures of racial isolation for example, in both Washington and in Minneapolis, where the proportions of minority students differ widely. Relative measures of desegregation thus focus on how well mixed students are, with complete racial balance as one extreme and complete segregation as the other. While not every district can have desegregated schools based on an absolute standard, any district in theory can have racially balanced schools. A number of the relative measures have corollary measures in the absolute measures and are of the form:

$$\frac{\text{Absolute measure}}{\text{Maximum absolute measure}}.$$

If the absolute measure has zero as its minimum, the relative measure is bounded by zero and one (or 100 percent). Table 1 lists a number of indices of each type that have been used or suggested.

One special variety of relative indices suggested by Pugh and others (1978) is an effort-based index. This index relates school segregation to residential segregation. Instead of using complete racial balance as the only reference point, it introduces the existing degree of residential segregation as a constraint with which local school officials

Table 1

List of Selected Segregation Indices

Absolute

1. Percentage of minority students in schools with 90%[a] or more minority enrollments.

2. Percentage of students in schools with more than 90% or fewer than 10% minority students.

3. Exposure - the racial composition in the average minority student's school.

$$MX = \sum_i \frac{M_i}{M} (\% W_i)$$

where M_i = minority enrollment in school i

$\%W_i$ = percent non-minority in school i

M = total minority enrollment

(The comparable non-minority index may be defined analogously.)

Relative (For all, 0 = no segregation; 100 = complete segregation.)

1. Percentage of minority students in schools with minority percentages over 20[a] points higher than the district average. (Compares to absolute index 1.)

2. Percentage of students in schools 20[b] or more percentage points from the district average.

3. Segregation Index.

$$1 - DI = 1 - \frac{MX}{\%W}$$

where % NM = percent non-minority in the district and MX is defined as above.

4. Dissimilarity Index

$$D = \frac{1}{2} \sum_i \frac{M_i}{M} - \frac{W_i}{W}$$

5. Concentration Index

$$CI = L/5000$$

where L = area between diagonal line and Lorenz curve, where the Lorenz curve is the graph of cumulative minority enrollment against cumulative non-minority enrollment.

6. Effort Index

---

a. obviously other percentages may be used (e.g., 95, 50, etc.)

b. again, other percentages can be used.

must deal. While it is not an absolutely binding constraint--racially balanced schools are possible where neighborhoods are segregated--residential patterns suggest one dimension of the difficulty of school desegregation. The more schools are desegregated "beyond" the level of neighborhoods, the greater the cost of desegregation in terms of transportation time and cost, perhaps parental concern, and usually political resistance. In addition, given recent Supreme Court decisions setting limits on the extent of Constitutionally-mandated desegregation, this index may have some role to play in court cases.

A Comparison of Several Major Segregation Indices

There have been a number of detailed analytical comparisons of alternative measures of school segregation.* In this section, we will attempt to illustrate and compare some of the best-known indices and several others that are less well-known. In order to illustrate the differences among the indices, a hypothetical school district is used for calculations.

Table 1 lists a number of absolute and relative measures of school segregation. Among the absolute measures, the percentage of students (or minority students) in schools within given racial composition ranges has been one widely-used way of measuring segregation. These measures correspond to the dichotomous concepts of racial isolation, as shown in Figure 1A and 1B. The third measure, called here the "exposure rate," is the percentage of another race encountered by the average member of a given racial group. A reduction in racial isolation would be indicated, for example, by a reduction in MX from 35 to 30 percent, assuming the overall composition of the district remained unchanged. The calculation of this index

*See, for example, Zoloth (1976) or Dziuban (1980).

may be illustrated by using the data given for a hypothetical school district in Table 2.

MX = [163(43.2) + 81(54.2) + 321(62.2) + 158(82.4) + 88(89.1)] / 811 = 64.4

The average minority student thus goes to a school that is 64.4 percent non-minority. The comparable measure for non-minority students is calculated as WX = 23.7, implying that the average non-minority student attends a school that has 23.7 percent minority enrollment.

The need for relative measures of segregation is apparent in these calculations, since the success a district has in balancing its schools is a function not only of its exposure rates but also of the maximum achievable exposure rates. The first two relative measures listed on Table 1 attempt to take into account the district's overall racial mix by defining isolation in terms of deviations from the mean racial composition. The second index can easily be illustrated for the example in Table 2. The percentage of students in schools more than 20 percentage points away from the mean (over 46.9% or under 6.9%) is 9.5 (School 1). By comparison, 42.1 percent of all students attended schools 15 percentage points away from the mean and 70.3 percent attended schools 10 points either side of the mean.

The third relative measure compares the calculated exposure rate and the corresponding overall racial percentage, in effect measuring the percent of the maximum exposure achieved. This ratio is measured by the desegregation index (DI):

$$DI = \frac{MX}{\%W} = \frac{WX}{\%M},$$

where NM and WX are exposure rates for minority and non-minority students and %NM and %M are corresponding percentages. In order to make this a

Table 2

School Enrollment in a Hypothetical District (Baseline Case)

School	Enrollments			Percent Minority	Cumulative Percent			
	Minority (M)	Non-Minority (W)	Total (T)		$\frac{M}{M}$	$\frac{W}{W}$	Minority	Non-Minority
1	163	124	287	56.8	20.1	5.6	20.1	5.6
2	81	96	177	45.8	10.0	4.4	30.1	10.0
3	321	529	850	37.8	39.6	24.0	69.7	34.0
4	158	739	897	17.6	19.5	33.5	89.2	67.5
5	88	717	805	10.9	10.9	32.5	100.0	100.0
Totals	811	2205	3016	26.9				

WX = 23.7 (Percentage minority encountered by average non-minority.)

1 - DI = 11.9 (1 minus desegregation index.)

D = 35.7 (Dissimilarity index.)

CI = 42.0 (Concentration index.)

measure of segregation, that is, assign a value of 0 to complete racial balance, this measure is subtracted from one. For the example in Table 2, this index is calculated:

$$1 - DI = \frac{WX}{-1\%} = 1 - \frac{23.7}{26.9} = 11.9.$$

This can be interpreted as, "This district has achieved all but 11.9 percent of the maximum possible exposure between minority and non-minority students." This index is referred to below as the Segregation Index.

The Dissimilarity Index may be calculated as:

$$D = \frac{1}{2} \sum_i \left| \frac{M_i}{M} - \frac{W_i}{W} \right|$$

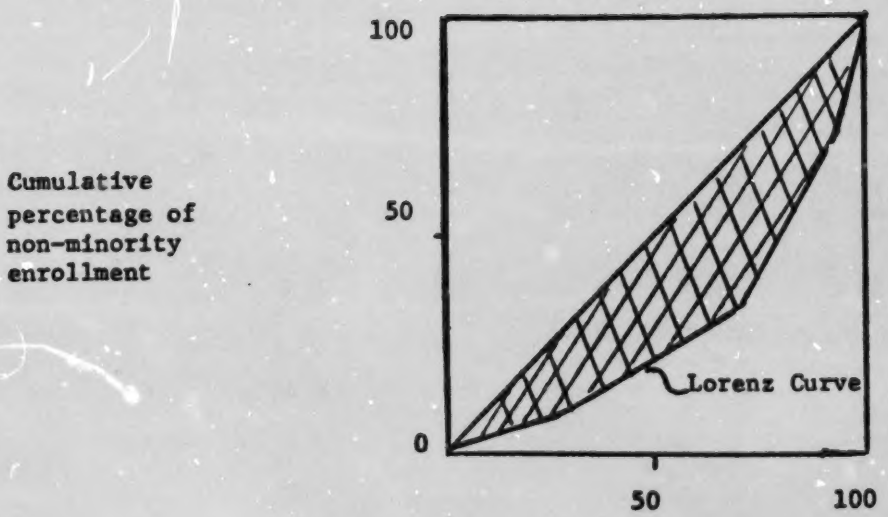
where M_i and W_i refer to minority and non-minority enrollments in school and M and W are district-wide enrollments. (Values of M_i/M and W_i/W are given in the Appendix under the Baseline Case.) This value is 35.7 for the example, interpreted as meaning that 35.7 percent of minority students would have to be moved to other schools for there to be racial balance in the district.

A fifth relative index is one not commonly used to measure segregation, but one commonly used in economic applications. This measure is based on a Lorenz curve and is referred to here as the Concentration Index. The Lorenz curve is calculated by, first, ranking all schools by percentage minority, starting with the most predominantly minority school. Then the cumulative percentage of minority and non-minority enrollments are graphed together, giving information such as, "The 30 percent of minority students in the most predominantly minority schools go to school with only 10 percent of the district's whites." These cumulative percentages are graphed in Figure 2. The concentration index is defined as

Figure 2

Lorenz Curve for Calculation

of Concentration Index



the shaded area divided by the area of the entire triangle. The more unequal the distribution of minority and non-minority students, the more closely the shaded area will correspond to the triangle. In the hypothetical district described above, this index is 42.0, implying that the shaded area is 42 percent that of the triangle.

A final relative measure of segregation is the Effort Index, as developed by Pugh et al. (1978). Instead of comparing actual racial mixing with maximum racial mixing in the district, the Effort Index compares actual racial mixing in schools with the racial mix of neighborhoods. (If the schools are more segregated than the corresponding neighborhoods, a district gets a poor score. Conversely, if the schools in a district are less segregated than the neighborhoods, a good effort score is achieved.) One way of illustrating this kind of index using the Lorenz curve would be to compare Lorenz curves for the schools and for neighborhoods. If the school curve is closer to the diagonal, a good score is obtained.

Although this is an innovative attempt at measurement, there are several problems with the measure. First, the calculation of neighborhood segregation--like school segregation--depends on the size of the unit of observation. Unlike schools, however, neighborhoods are not well-defined and statistical units such as census tracts are arbitrary. Thus the standard of comparison--neighborhood integration--is subject to arbitrary definitions. Second, if one uses school district attendance zones as neighborhoods, data collection will be a major problem. Not only are attendance zones and tracts not coincident, but census data are available only every decade.

Comparison of Relative Indices

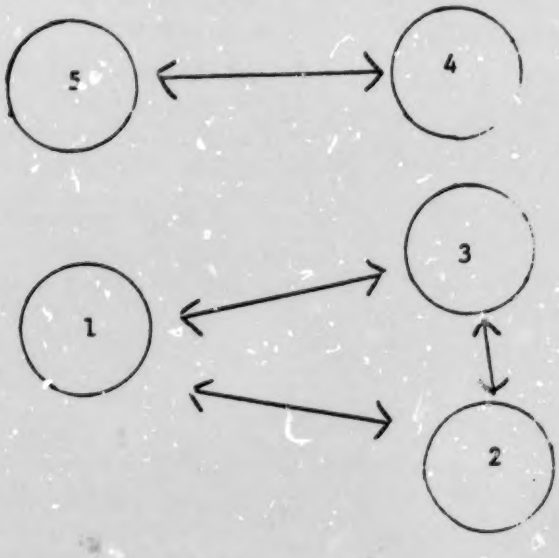
Because they may be compared between districts with different racial compositions, relative indices are preferable to absolute indices for most applications. In order to analyze the characteristics of various relative

indices, calculations were performed for several cases based on the hypothetical district described above in Table 2. Comparing these concrete examples makes it possible to illustrate general characteristics of the indices. In the discussion that follows, the benchmark is the situation shown in Table 2, referred to as Case I. For each of the other cases, the racial composition of schools are altered according to some rule. However, the total enrollment in each school is assumed to remain the same as that given in Table 2, since total enrollments in each school are presumably limited by the school's capacity.

In Case IA, the racial compositions of schools 1, 2, and 3 (those with the largest proportions of minority students) are evened, as are the compositions of schools 4 and 5. Although compositions are only partially evened, it would be fair to say that some desegregation had occurred. Indeed, this is evident from the decline in the Segregation Index from 11.9 to 10.4 and the decline in the Concentration Index from 42.0 to 36.2 (see Table 3). However, the Dissimilarity Index does not change at all. This illustrates the feature, previously noted by Zoloth (1976), that the Dissimilarity Index is a function only of the number of students attending schools with compositions above and below the district mean. The composition of those schools on either side does not affect D. Another way to see this is by observing, as Duncan and Duncan (1955) showed, that D is simply the vertical distance between the Lorenz curve and the diagonal line, as shown in Figure 3. Since in both cases 69.7 percent of minority students go to schools with 34 percent of non-minority students, the vertical distance does not change. While this relationship shows why D and the Concentration Index come out so close, it is certainly a weakness of the Dissimilarity Index that it does not reflect changes such as that between Cases I and IA.

Case IA

Description: Racial compositions of schools 1, 2, and 3 are balanced together and schools 4 and 5 are balanced together.



Result:

School	M	W	T	M%
1	123	164	287	43.0
2	76	101	177	43.0
3	366	484	850	43.0
4	130	767	897	14.5
5	116	689	805	14.5
Totals	811	2205	3016	26.9

WX = 24.1

1 - DI = 10.4

D = 35.7

CI= 36.2

Table 3

Comparisons of Segregation Index

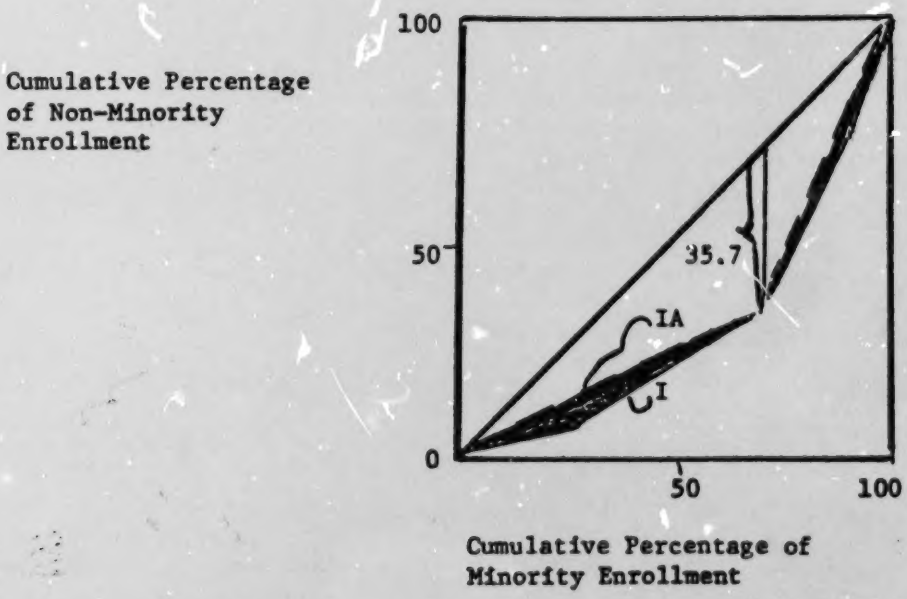
Calculations for Hypothetical Cases

	IV	IB	I	IA	II	III
1 - DI (Segregation Index)	62.1	34.6	11.9	10.4	2.6	2.2
D (Index of Dissimilarity)	85.2	35.7	35.7	35.7	21.2	15.6
CI (Concentration Index)	87.8	57.5	42.0	36.2	24.8	16.1
Percentage of students attending racially isolated schools, defined as:						
a) outside ± 20% of mean percent minority (over 46.9, under 6.9)	100.0	36.2	9.5	0	5.9	0
b) outside ± 15% of mean (over 41.9; under 11.9)	100.0	36.2	42.1	43.6	5.9	0
c) outside ± 10% of mean (over 36.9; under 16.9)	100.0	36.2	70.3	100.0	34.1	28.2

Figure 3

Comparisons of Lorenz Curves

for Cases I and IA



A further example will illustrate this weakness more graphically. Case IB retains the total enrollment of minority students in schools above and below the district average but segregates those schools within each group. The result is one all-minority school and one school with fewer than 2 percent minority students. Because the number of both groups of students does not change between schools above and below the average racial composition, the Dissimilarity Index does not change. Yet segregation is clearly increased, as indicated by the increases in the other two indices. A major weakness of the Dissimilarity Index is, therefore, that it measures only one aspect of the distribution of school racial compositions. Although it normally moves with other indices, it can be "fooled." It would not be impossible, for example, for a district to increase actual segregation in its schools while leaving the Dissimilarity Index unchanged.

Cases II, III, and IV are variants of the baseline Case I. Case II simulates a limited attempt to desegregate schools by pairing schools 1 and 5 and balancing their racial compositions. As shown in Table 3, the values of all indices decline, indicating desegregation. However, it should be emphasized that the amounts of each decline are not comparable. The Segregation Index declined 78 percent of its original value while the Dissimilarity Index and the Concentration Index both declined only 41 percent. Figure 4 shows the Lorenz curves for cases I-IV. The desegregation achieved by Case II's pairing is shown by the dotted line lying closer to the diagonal than the line for Case I. Case III simulates a more complete desegregation effort, in which two sets of schools are paired. The result is that four schools have racial compositions within a percentage point of one another and the fifth is some 14 percentage points away. The Segregation Index shows this as almost completely desegregated, with an index of 2.2, while D and CI are 15.6 and 16.1, respectively.

Case IB

Description: Segregation is increased by concentrating minority students in school 1 and non-minority students in school 5.

School	M	W	T	% minority
1	287	0	287	100.0
2	48	129	177	27.1
3	230	620	850	27.1
4	233	664	897	26.0
5	13	792	805	1.6
Totals	811	2205	3016	

D = 35.7

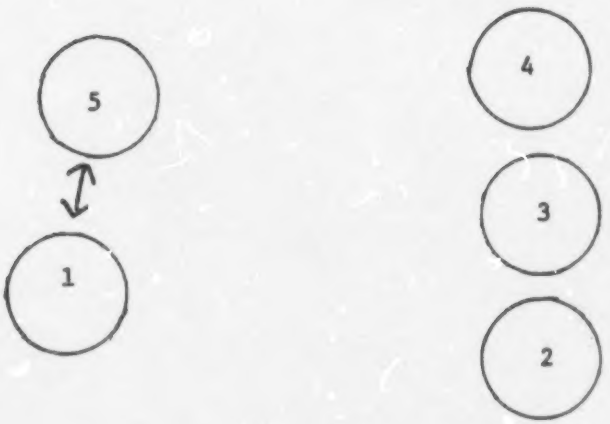
WX = 17.6

1 - DI = 34.6

CI = 57.5

Case II

Description: Only schools 1 and 5 are paired and racially balanced.



Result:

School	M	W	T	% M
1	66	221	287	23.0
2	81	96	177	56.8
3	321	529	850	37.8
4	158	739	897	17.6
5	185	620	805	23.0
Totals	811	2205	3016	26.9

WX = 26.2

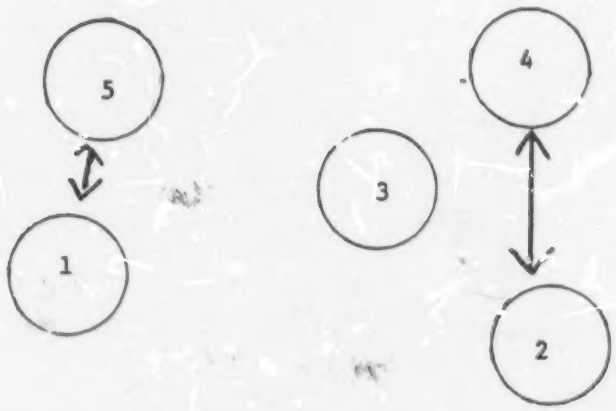
1 - DI = 2.6

D = 21.2

CI = 24.8

Case III

Description: Schools 2 and 4 are paired and racially balanced in addition to schools 1 and 5 (Case IB).



Result:

School	M	W	T	% M
1	66	221	287	23.0
2	39	138	177	22.3
3	321	529	850	37.8
4	200	697	897	22.3
5	185	620	805	23.0
Totals	811	2205	3016	26.4

WX = 26.3

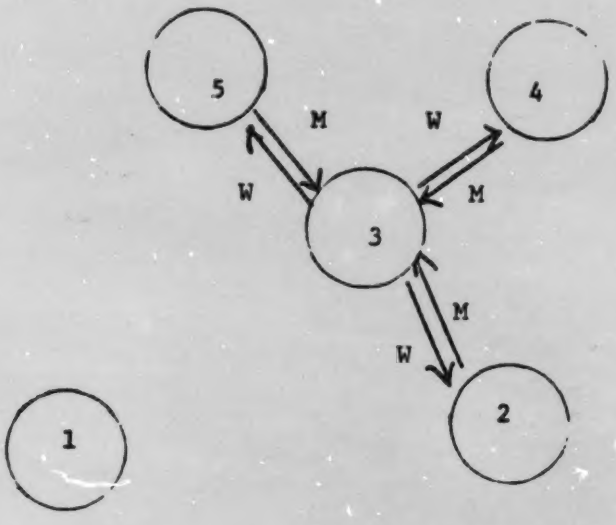
1 - DI = 2.2

D = 15.6

CI = 16.1

Case IV

Description: Official segregation: all minority students in schools 2, 4 and 5 ~~are~~ sent to school 3 in exchange for equal numbers of non-minority students.



Result:

School	M	W	T	% M
1	163	124	287	56.8
2	0	177	177	0
3	648	202	850	76.2
4	0	897	897	0
5	0	805	805	0
Totals	811	2205	3016	26.9

WX = 10.2

1 - DI = 62.1

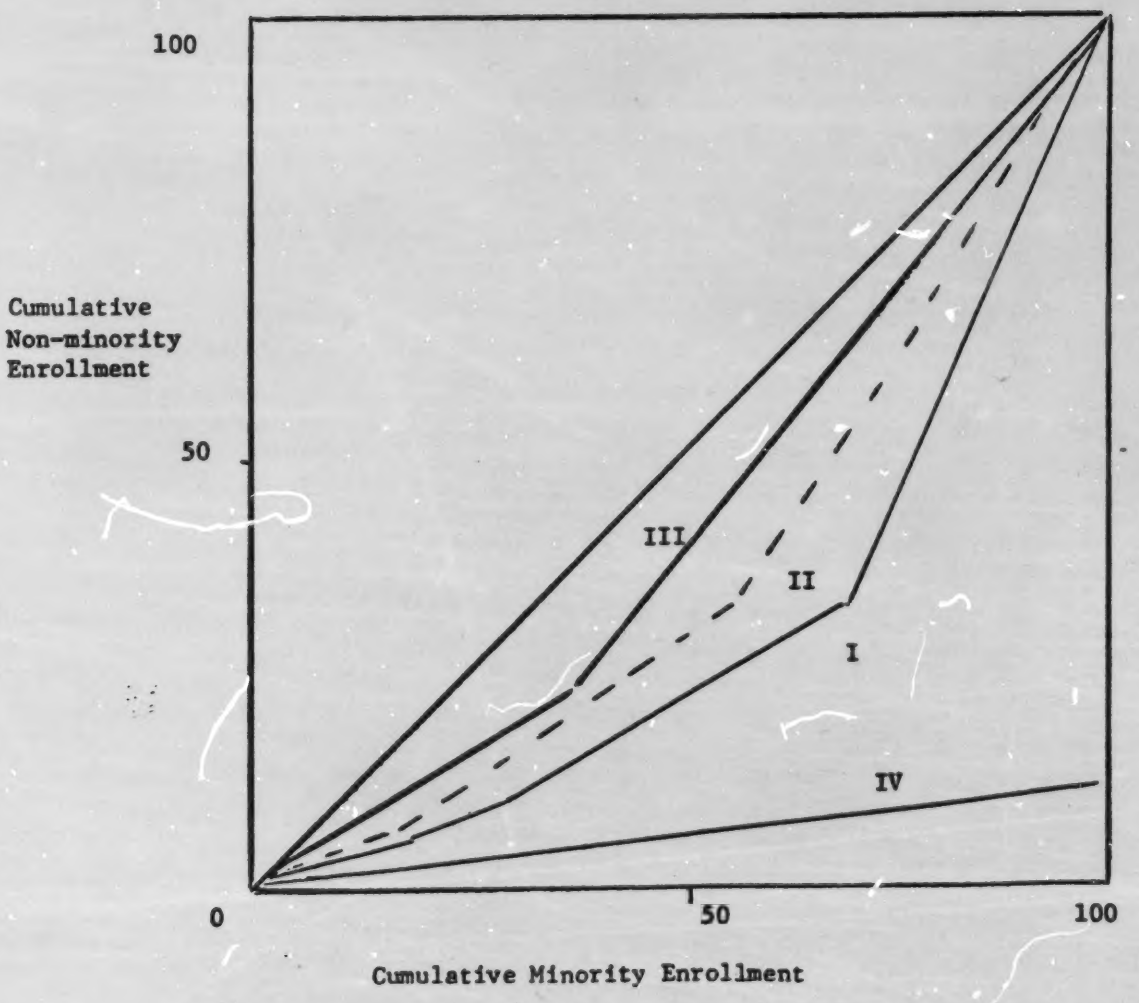
D = 85.2

CI = 87.8

Figure 4

Lorenz Curves for Four

Hypothetical Cases



Finally, a deliberate increase in segregation is simulated in Case IV. All minority students are transferred out of three schools. This results in the expected increases in measured segregation. Again, D and CI are about 20 points higher than 1-DI. Clearly, one should not make too much of the percentage changes in any index, however, for the magnitudes of such changes differ significantly among indices.

Conclusion and Evaluation

Figure 5 presents a summary of four segregation measures for the six cases described in section D. As the cases are arrayed from "most" to "least" segregated, two of the indices (1-DI and CI) fall throughout and one falls or remains constant (D). The fourth index, the percentage of students in schools more than 15 percentage points from the mean racial composition, generally falls except for one upward tick from Case IB to Case I.

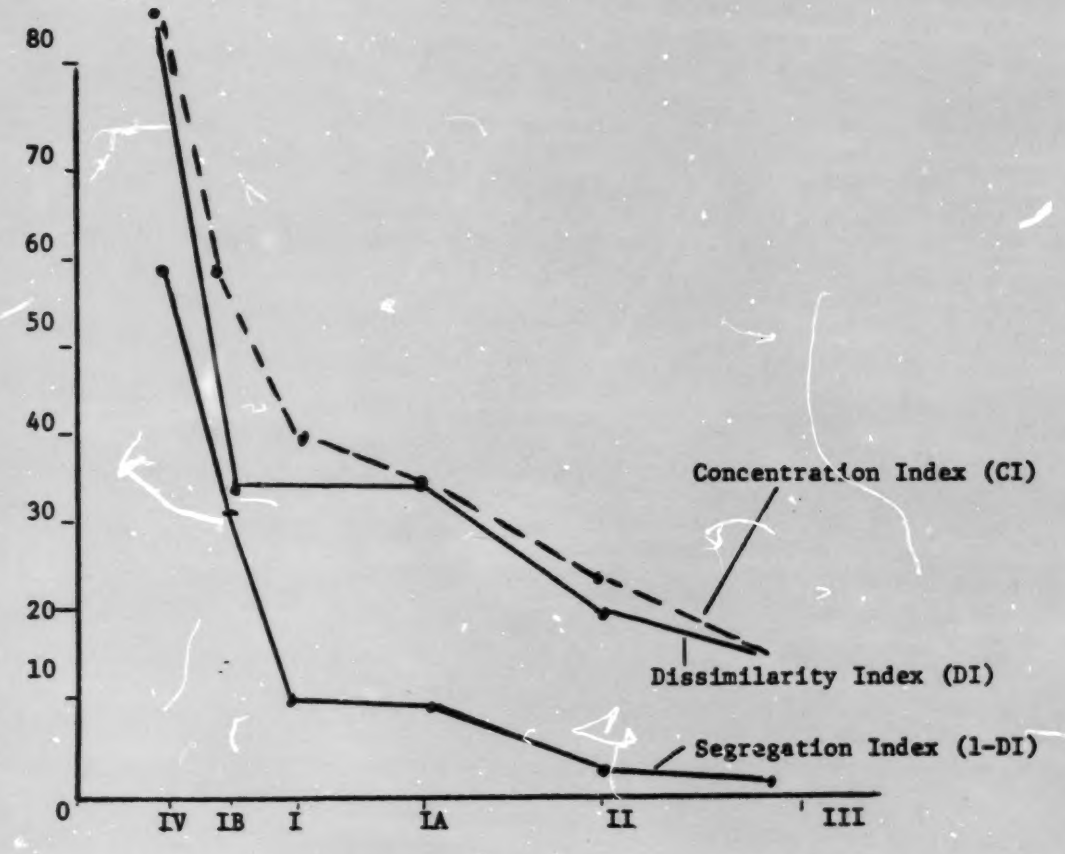
Based on these simulations and the previous work of others, we can make the following observations about commonly-used measures of school segregation.

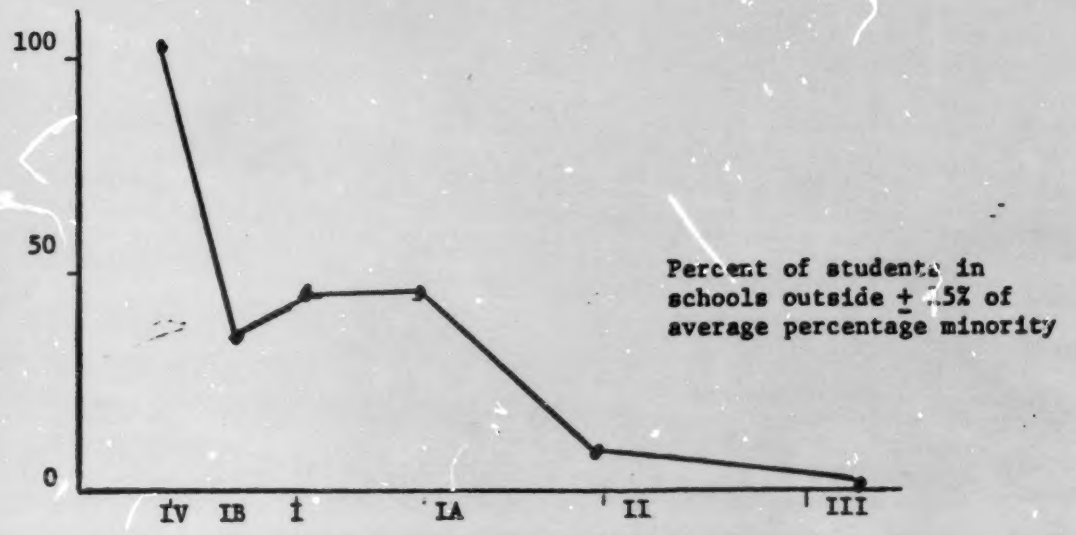
1. Absolute measures of segregation may be most useful in determining behavior (e.g., white flight) or damage (e.g., due to segregation), but they are impractical for policy purposes because they do not control for the overall racial composition of school districts.
2. Relative measures of segregation have the following properties in common: they assign a value of 0 to racially balanced schools. Aside from those points of agreement, they may differ markedly. For example:
   a. The Dissimilarity Index is unaffected by changes in school compositions that leave unchanged the number of minority

Figure 5

Index Calculations for Five

Hypothetical Cases





and non-minority students in schools above and below the average percent minority.

b. The Dissimilarity Index and Concentration Index are quite close, although the latter index does not have the weakness noted in 2a.

c. Both CI and D tend to be higher than (1-DI) for any given racial distribution. This is true not only in the simulations shown here, but also in the calculations done by Zoloth (1976), as illustrated in Table 4.

3. All of the relative indices use racial balance as the "ideal" on which an index value of zero is based. As Cortese, Falk, & Cohen (1976) note, however, this may not be an appropriate point of comparison. They argue, instead, that desegregation ought to correspond to a random assignment of all students; yet a random assignment would normally lead to measured segregation, because it would not likely produce a perfectly even distribution. For example, their figures imply that in a school system with 100 students per school and an overall racial composition of 20 percent minority that a random assignment would be expected to produce a Dissimilarity Index of 9.9 (p. 632). The Segregation Index (1-DI) would most likely yield a much smaller value, though it also would be positive.

In conclusion, this assessment points up several important problems with the popular Dissimilarity Index. Although it is well-known, comparatively easy to calculate and easy to interpret, the Segregation Index (1-DI) appears to be better. Not only is the Segregation Index, which is the measure employed by the Office for Civil Rights, also easy to calculate and interpret, it

Table 4

Segregated Indices for

Selected Districts in

1972

	D	1 - DI
Birmingham	76.1	65.2
Los Angeles	68.8	56.0
Hillsborough Co., Florida	18.1	4.0
Atlanta	80.2	61.8
Chicago	79.9	68.9
Louisville	80.3	71.0
Baltimore	82.2	69.4
Boston	70.8	58.3
Detroit	74.5	60.4
Jackson	38.7	18.1
New York City	67.2	48.9

Source: Zoloth (1976, pp. 294-298).

appears to be more sensitive to changes in effective segregation. The Concentration Index appears to be superior to the Dissimilarity Index in its sensitivity to changes and its ability to be illustrated, although it is somewhat more difficult to interpret.

III. Computing the "Effective Net Reduction" in Racial Isolation in the Award of ESAA Funds

Introduction

Criteria for allocating ESAA funds include a ranking within categories of school districts in terms of the amounts of reduction in racial isolation that their plan will achieve. In early 1980, the previous formula was altered to eliminate bias against districts with large minority populations. Our analysis indicates that this change achieved some of its objectives, but that a more direct measure will eliminate bias in the existing system.

Ambiguities in Defining "Racial Isolation"

The problem addressed by the new formula for measuring the reduction in "racial isolation" was to not unfairly penalize a certain group of districts. The notion of reducing "racial isolation" implies that it is better to have minority students in school with non-minority students than in all-minority schools. Beyond that, however, there are any number of indices that will measure the severity of racial isolation. The Addendum to this section presents a comparison of three such indices: a dichotomous index; what we will call the NPRM (Notice of Proposed Rule Making) index used in ESAA decision making; and a minority "exposure" index.* Although they differ in the precise weights given, all of these indices

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*This Addendum is repetitive to a large extent of this discussion in the previous section. We include it here on the assumption that the section of this paper might interest different readers, and thus should stand on their own.

tend to show a reduction in racial isolation when minority students are moved from predominantly minority to predominantly majority schools.

A serious problem with any index of this sort--including the ESAA index--is that it tends to penalize districts which have large minority populations and experience increases in the overall proportion of minority students. A district with 10 percent minority students can have all of its minority students in schools with less than 50 percent minority enrollments, but this is impossible for a district with a 60 percent minority enrollment. In deciding how to compare the reduction in racial isolation of various districts, how can these changes beyond the control of the districts be controlled for?

The Two-Index Solution

The solution arrived at in the new ESAA ranking formula is to calculate what amounts to both a percentage and an absolute change in weighted minority enrollments and to use the average of the two resulting ranking. This solution seems to be based on the observation that large school districts have experienced the largest percentage increases in minority enrollments and are thus most severely disadvantaged by the NPRM method of calculating reduction in racial isolation.

While this correction may tend to approximate a solution to the inequity of imposing an unaltered NPRM index, it focuses on the wrong variable and thereby will tend to create other inequities. It is not the size differences in districts that are the problem, but rather the differences and changes in overall racial compositions across districts. If two districts have the same number and racial composition of schools and each imposes identical desegregation plans, their per-pupil reduction in racial isolation will be the same no matter what their relative sizes

are. Size has no place in the evaluation of reduction in racial isolation.

Simulation

In the simulation below, a simple example of two like-sized districts, one of which has an increase in minority enrollments, is presented.

Base Case. Consider two districts, each of which begins with ten schools and identical racial compositions.

Initial Enrollments in Districts 1 + 2

(1)	(2)	(3) Enrollment	(4)	(5)	(6)	(7)
School	Minority	Non-Minority	Total	Percent Minority	NPRM Weight	(2) X (6)
1	98	2	100	98	0	0
2	96	4	100	96	0	0
3	85	15	100	85	.2	17
4	70	30	100	70	.5	35
5	50	50	100	50	1.0	50
6	40	60	100	40	1.0	40
7	10	90	100	10	1.0	10
8	2	98	100	2	1.0	2
9	2	98	100	2	1.0	2
10	2	98	100	2	1.0	2
Total	455	545	1000			158

The NPRM index is .347 (158/545).

Time Two. Between the base year and the second observation of each district, both districts desegregate by exchanging 100 minority students from the highest percentage minority schools (schools 1 + 2) with 100 majority students from the lowest (schools 9 and 10). In addition,

schools in district 2 experience an increase in minority enrollments equal to 10 percent of the original minority enrollment in each school. The resulting enrollments are shown in the next two tables.

New Enrollments in District 1

(Desegregation; No Change in Overall Enrollments)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Enrollment			Percent	NPRM	
School	Minority	Non-Minority	Total	Minority	Weight	(2) X (6)
1	48	52	100	48	1.0	48
2	46	54	100	46	1.0	46
3	85	15	100	85	.2	17
4	70	30	100	70	.5	35
5	50	50	100	50	1.0	50
6	40	60	100	40	1.0	40
7	10	90	100	10	1.0	10
8	2	98	100	2	1.0	2
9	52	48	100	52	.9	46.8
10	52	48	100	52	.9	46.8
Total	455	545	1000			347.6

The new NPRM index for district 1 is .764 (347/455), a change of +.417.

New Enrollments in District 2

(Desegregation; 10 Percent Increase in Minority Enrollments)

(1) School	(2) Minority	(3) Non-Minority	(4) Total	(5) Percent Minority	(6) NPRM Weight	(7) (2) X (6)
1	58	52	110	53	.9	52.2
2	56	54	110	51	.9	50.4
3	94	15	109	86	.2	18.8
4	77	30	107	72	.5	38.5
5	55	50	105	52	.9	49.5
6	44	60	104	42	1.0	44.
7	11	90	101	11	1.0	11.
8	2	98	100	2	1.0	2.
9	52	48	100	52	.9	46.8
10	52	48	100	52	.9	46.8
Total	501	545	1046			360.0

The new NPRM index for district 2 is .719 (360/501), an increase of only +.372. Although both districts pursued identical desegregation plans, the measured decrease in racial isolation in district 2 is less, merely because of demographic changes beyond the control of district 2. While one could agree that racial isolation was indeed greater in district 2, the motivation behind the new ESAA strategy obviously is that it would not be fair to penalize district 2 for changes over which it had no control.

Attempts to correct these NPRM changes for the change in overall racial composition were not successful. However, an application of the Desegregation Index (DI) discussed in Section II does provide a way to correct for the change in overall racial composition. Define DI = MX/%NM where MX is the minority exposure index defined in Addendum and %W is the

proportion of non-minority students in the district. The following table summarized the calculation of this index for these two districts.

Desegregation (DI) Index Calculations

Base Case	District 1	District 2
MX	.227	.227
ZW	.545	.545
C	.58	.58
After Desegregation	**District 1**	**District 2**
MX	.425	.405
ZW	.545	.521
DI	.22	.22

In other words, this index successfully accounts for the differences in demographic experiences between the two districts. If this index were employed for the ESAA program, it would be unnecessary to introduce size into the decision process in order to achieve an equitable rule.

Conclusion

The simple simulation above is a short-hand way of illustrating what a more elaborate analysis would also show:

1. increases in minority enrollments and decreases in non-minority enrollments will tend to show up as an increase in racial isolation, holding school policy constant,
2. there is no simple way to correct the NPRM method for such changes, and
3. the use of a minority exposure index can successfully correct for changes in the overall racial composition.

These conclusions suggest that districts should be ranked in terms of the effort made to desegregate not by the present ESAA two-index "solution" but by the Desegregation Index (DI).

ADDENDUM

A Comparison of Three Measures of the Reduction in Racial Isolation

This appendix considers three indices, each of which assigns more weight to minority enrollment in "non-isolated" schools than in "isolated" schools. First, a dichotomous measure might define schools with 50 percent or more minority enrollments as "racially isolated." The index of progress in desegregation would then be the percentage of minority students in non-isolated schools (0 - 50% minority). A second measure might establish degrees of racial isolation between 50 and 100 percent minority, as the Notice of Proposed Rule Making (NPRM) method does. According to this method minority enrollments in predominantly minority schools are weighted according to racial composition. For example, minority enrollments in schools 95% minority receive no weight, schools 70 - 74.9% receive 0.5 and schools 50% or less receive full weight. Figure 1 compares the first two methods in their weighting of various degrees of "racial isolation." A third measure of desegregation progress is the so-called "racial exposure" index. In this case, the minority exposure index is defined as the proportion non-minority in the average minority student's school:

$$MX = \left[\sum_i (\%W_i) \quad (M_i) \right] / \sum_i M_i ,$$

where W_i and M_i are the number of non-minority and minority students in school i and where $\%W_i$ is the percentage of non-minority students in school i. The weights implied by this measure for various racial compositions are shown in Figure 6. Whereas the first two methods give equal weight to

minority enrollments in all schools with over 50 percent minority populations, the minority exposure index gives weights in proportion to the non-minority population. All three methods imply that a minority student in a 99 percent non-minority school is less racially isolated than one in a 99 percent minority school, but each assigns different weights to racial compositions in between.

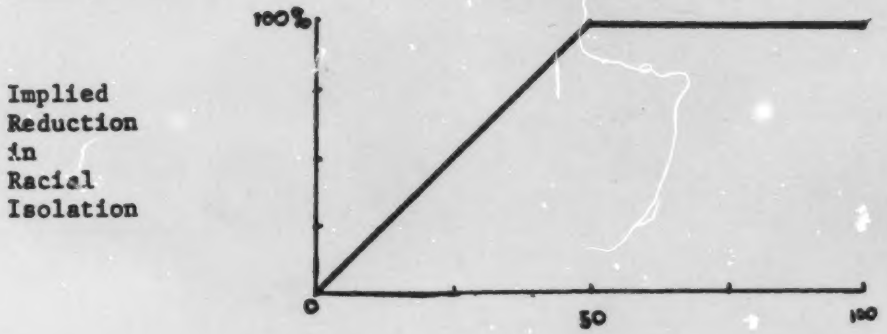
Figure 6

Comparison of Three Measures of

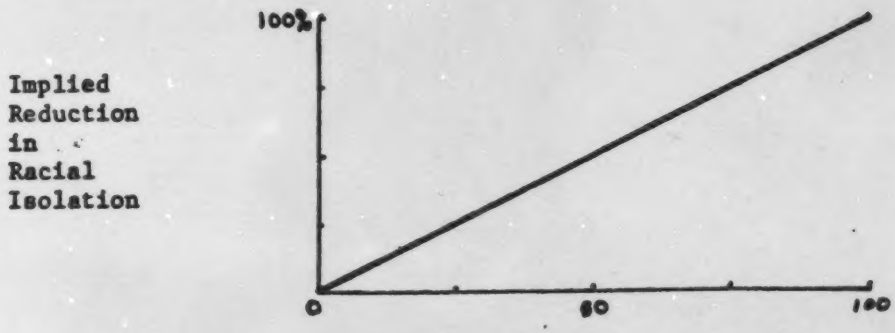
Reduction in Racial Isolation

Dichotomous

NPRM



Minority Exposure Index



IV. Desegregation, Resegregation and Net Benefits Over Time

One dilemma faced by policymakers concerns the trade-off between the benefits of school desegregation and unintended consequences, such as "white flight." Desegregation is pursued because our society has determined that there are benefits that arise out of contact between minority and other children, that is, out of the elimination of "racial isolation." Empirical work on "white flight" has shown, however, that many whites try to leave or avoid desegregated schools. This avoidance not only leads to the "resegregation" of schools, but it may also result in increased residential segregation in urban areas. The purpose of this note is to present a simple model for considering these costs and benefits of desegregation over time.

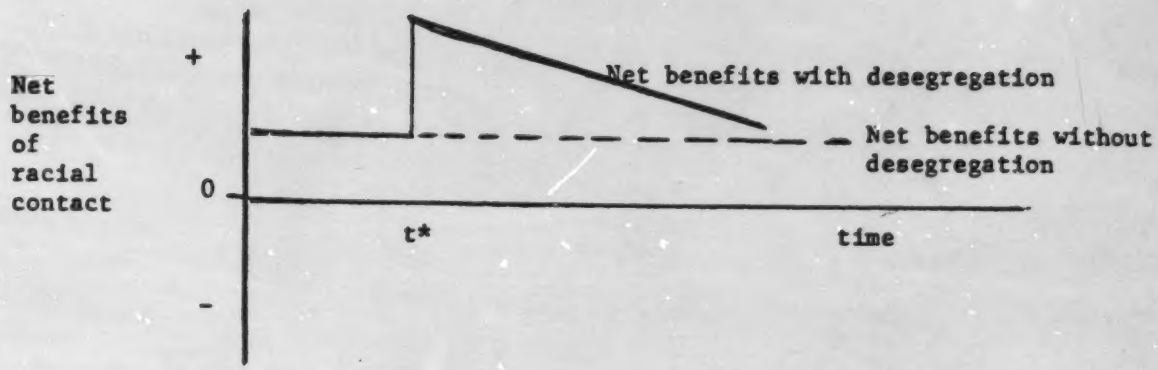
Figure 7 presents a hypothetical graph of net benefits of racial contact in schools over time, where the official date of school desegregation is year t*. In this graph, the net benefits of racial contact in the district are assumed to increase dramatically in the year of desegregation. In succeeding years these net benefits fall due to resegregation. The net benefit of school desegregation itself is the vertical distance between the net benefit curve and the dotted vertical line, showing the net benefits existing before (or in the absence of) the desegregation activity in year t*.

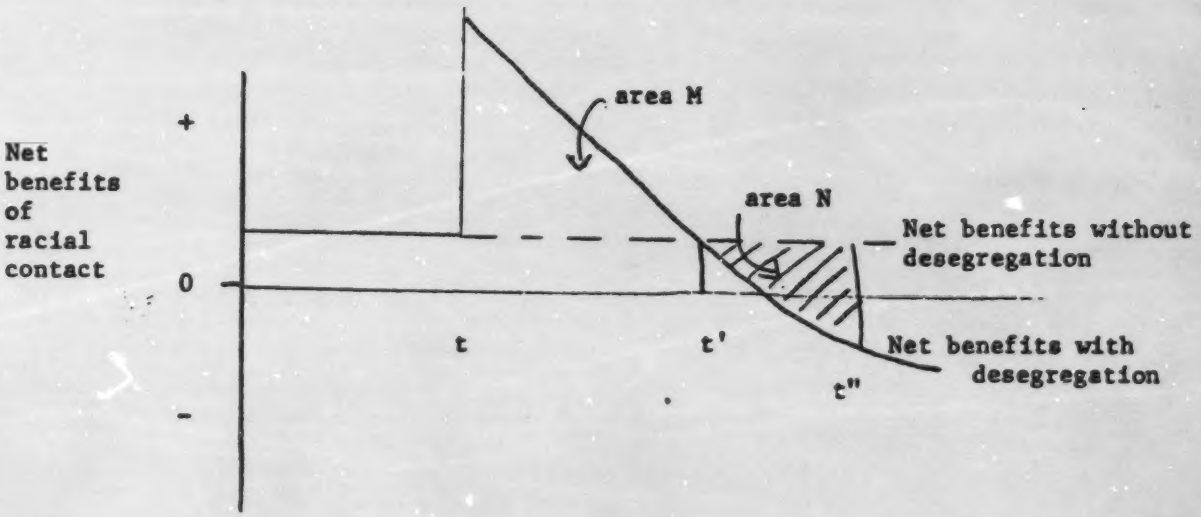
As long as the desegregation benefit line is higher than the dotted line, desegregation is clearly a success because it has increased net benefits to society. But what if the desegregation net benefit line crosses under the dotted no-desegregation curve, as shown in Figure 8 ? The curves in Figure 8 imply that the net benefits following desegregation are actually lower after year t*, than they would have been in the absence of desegregation activity.

Figure 7

Hypothetical Net Benefits of

Desegregation





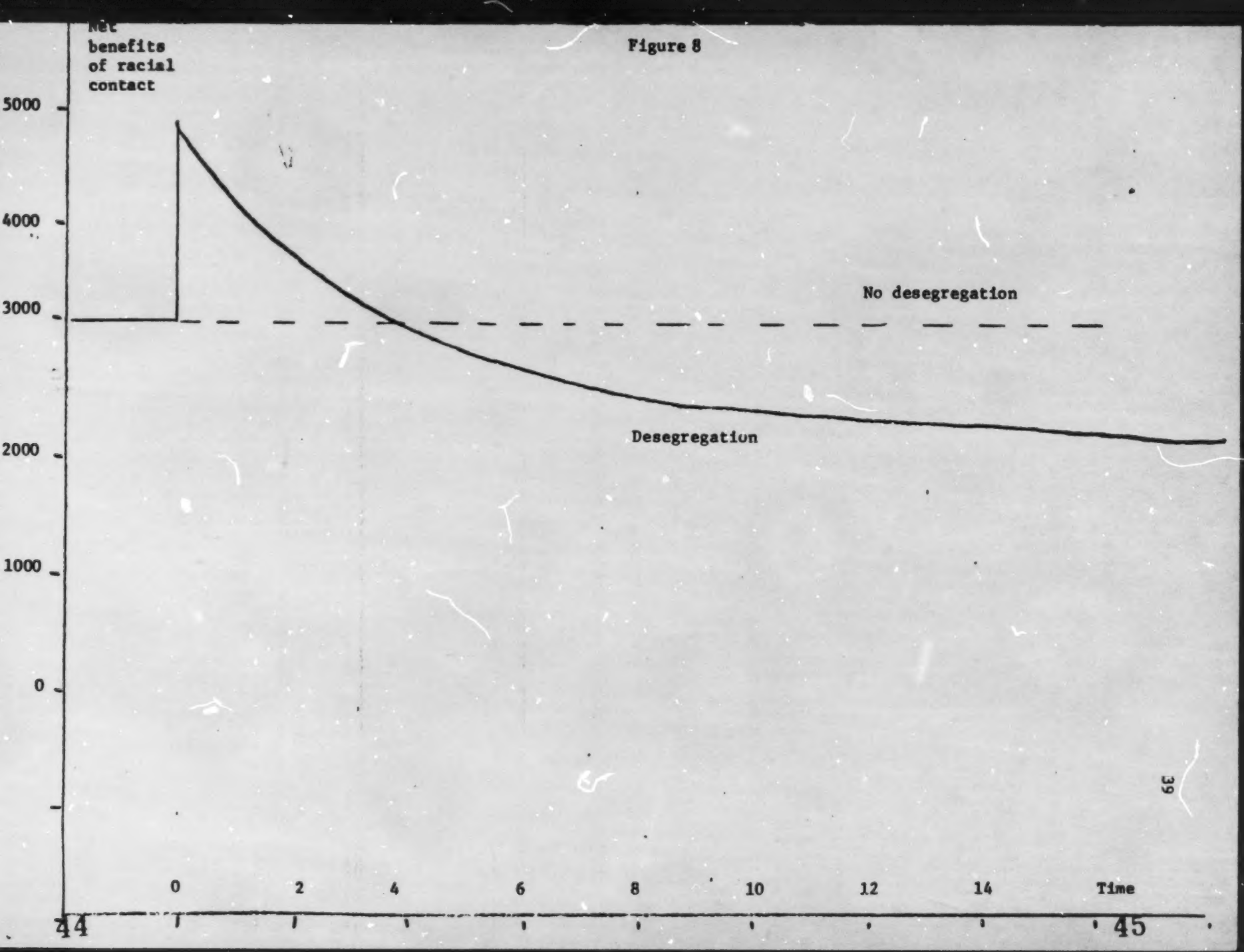

Net benefits of racial contact
5000
4000
3000
2000
1000
0
No desegregation
Desegregation
0
2
4
6
8
10
12
14
Time

Figure 8

In this case, it is necessary to compare the extra benefits that desegregation offers over the no-desegregation (indicated by area M) against the extra costs (indicated through year t" by the area N). In this sense, desegregation may in principle be evaluated as are other long-lived public policies and projects. Following this analogy, one can define the present value of net benefits from desegregation as:

$$V = PV\ (B_t - B_o) = \sum_{t=1}^{T} \frac{B_t - B_o}{(1 + r)^t}, \qquad (1)$$

where B_t and B_o are the net benefits of racial contact with and without desegregation and r is the rate of discount.

This simple analysis points up five important questions that must be considered in making such an evaluation:

1. What is the benefit of racial contact in the schools? Whether this benefit is expressed in dollars or in terms of some other reference good, this is a fundamental question. If society places no value on racial contact, then desegregation would obviously not be worth any costs.
2. What are the additional costs associated with desegregation? These might include the costs of transportation, administration, and disruption. A complete analysis would require that these costs be expressed in units comparable to the benefits above.
3. How does school desegregation affect the number of whites in a district and the degree of residential segregation in the local housing market?

4. What are the benefits of residential desegregation?

5. How should costs and benefits in future years be compared to costs and benefits today, i.e., what is the rate of discount?

A Model of Desegregation and White Flight

In order to give these questions a concrete application, I present below a simple model of desegregation and white response. Consider a district with a constant minority population of students and a variable number of whites. The proportion of whites in the district (W) is determined by the number of whites in the district, which is in turn a function of the extent of desegregation (D). Desegregation affects the desired proportions of whites in the district, that is, the percentage of the district composed of whites who want to remain (W*):

$$W^* = W^*(D) \qquad (2)$$

An increase in desegregation is assumed to reduce this desired proportion of whites, but the actual white percentage changes slowly due to the difficulty of moving, and transferring schools and to the lags in the construction of new housing. The actual white percentage is assumed to adjust incrementally towards the desired percentage, as given by a partial adjustment model:

$$W_t - W_{t-1} = s\ (W_t^* - W_{t-1}), \qquad (3)$$

where W_t and W_{t-1} are the white proportions in year t and t - 1 and S is a constant, $D < s \geq 1$.

The benefits of racial contact are expressed as a function of the extent of desegregation and the proportion of whites in the district:

$$B = B(D, W), \qquad (4)$$

Racial contact for minority students rises with both D and W, thus both derivatives are assumed to be positive. Combining equations (2) and (4) and differentiating yields the effect of desegregation on the net benefits of racial contact:

$$\frac{dB}{dD} = B'(W^*)\frac{dW^*}{dD} + B'(d), \qquad (5)$$

where $B'(W^*)$ and $B'(D)$ are partial derivatives of benefits with respect to W^* and D, respectively. The partial effect of desegregation, $B'(D)$, is of course, positive, but, because (dW^*/dD) is negative, the sign of the entire expression is ambiguous. If the induced white flight is great enough, the long-run effect of desegregation may be detrimental.

In order to be more specific, consider the following rewritten model:

$$W^* = aD^{-g} \qquad (6)$$

$$W_t - W_{t-1} = s(W^* - W_{t-1}) \qquad (3)$$

$$B_t - W_t^p D^q \qquad (7)$$

where D is the extent of desegregation assumed to remain constant after the "year of desegregation" and g, p, and q are parameters. Desegregation will increase the net benefits of racial contact in the long run if $q > gp$, since the elasticity of B with respect to D [combining (6) and (7)] is $(q - gp)$. In other words, as long as the benefit received from the extent of desegregation exceeds the joint effect of the loss of whites, desegregation will have positive net benefit in the long run.

In order to examine the pattern of benefits over time, however, it is necessary to consider all three equations. For the purpose of simulation, assume $g = q = 1$, $p = 2$ and $s = .1$. The latter value implies that only 10 percent of the desired charge in percent white takes place in a year.

Finally, assume the following starting values:

$D_o = 0.5$ (before "desegregation")

$D = 0.75$

$a = 40$

$W_o = 80$

Equation (6) implies that the increase in desegregation from 0.5 to 0.75 results in a new desired percentage white:

$$W^* = 40/.75 = 53.3$$

The actual percentage white one year after desegregation is:

$$W_1 = 80 + .1\ (53.3 - 80) = 77.3$$

The benefit of racial contact increases from 3200 $[(80)^2\ (.5)]$ before desegregation to 4481 $[(77.3)^2\ (.75)]$ after one year of desegregation. Table 1 summarizes these simulated changes, and Figure 2 graphs the net benefit figures.

It is clear in this example that desegregation produces positive net benefits in the early years after desegregation but that white losses over time serve to diminish racial contact until benefits fall beneath the no-desegregation level at the end of eight years. [It is worth noting that Rossell (1978) finds that desegregation has net benefits for a similar period.] Now, can we say that desegregation is or is not worth the costs in this case? The answer to this question depends on the rate of discount. If present and future benefits are treated equally*, that is, the discount rate is zero, the present value of the stream is simply the sum of the $(B_t - B_o)$ terms, which will be a negative number (specifically, minus infinity). However, this stream appears to be positive at the same

*We ignore inflation by expressing all figures as constant dollar amounts.

discount rates. For example, a discount rate of 4 = .08 yields a present value of $2211 after 10 years, while smaller discount rates will produce less favorable results, larger rates will produce more and more positive results.

This model and simple example serve to illustrate that desegregation policy may--or may not--be worthwhile when the long term costs of resegregation are taken into account. The answer must depend on the determination of the responsiveness of whites to desegregation, the benefits and costs of desegregation itself, and the proper discount rate.

Table 5

Simulated White Enrollment and Net Benefits

for Hypothetical Example

Year	D	Percentage-Whites		Net Benefits from racial contact	
		Desired (W^*)	Actual (W_t)	B_t	$B_t - B_o$
Previous	0.5	80	80	3200	0
1	0.75	53.3	77.3	4481	1281
2	0.75	53.3	74.9	4208	1008
3	0.75	53.3	72.7	3964	764
4	0.75	53.3	70.8	3760	560
5	0.75	53.3	69.1	3581	381
6	0.75	53.3	67.5	3417	217
7	0.75	53.3	66.1	3277	77
8	0.75	53.3	64.8	3149	- 51
9	0.75	53.3	63.6	3034	-166
10	0.75	53.3	62.6	2939	-261
11			61.7	2855	-345
12			60.9	2782	-418
13			60.1	2709	-491
14			59.4	2645	-555
15			58.8	2593	-607
16			58.3	2549	-651
Long run					

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